

REMARKS

Claims 2-7, 9, 11-15, 17-23, 25-35 and 37-61 have been rejected by the Examiner under 35 USC 103 as being unpatentable over Luciani et al., EP 0480435 (hereinafter referred to as Luciani I). Also, claims 2-7, 9, 11-15, 17-23, 25-35 and 37-61 have been rejected by the Examiner under 35 USC 103(a) as being unpatentable over Luciani et al., EP 0522651 (hereinafter referred to as Luciani II). Finally, claims 2-7, 9, 11-15, 17-23, 25-35 and 37-61 have been rejected by the Examiner under 35 USC 103(a) as being unpatentable over WO 91108239 (hereinafter referred to as Neste). These rejections are respectfully traversed.

As the Examiner will note, by the present Amendment, claims 29, 30, 35 and 52 have been cancelled from the present application and claims 62-73 have been added to the present application and accordingly claims 2-7, 9, 11-13, 15, 17-23, 25-28, 31-34 and 37-73 are presently under consideration in the present application.

The Examiner, Dr. James McDonough, and the Examiner's Supervisor, Mr. Jerry Lorengo, are thanked for the courteous interview extended to the inventor, Dr. Miranda, her associate, Mr. Olavo and the Applicants' attorney Joseph Kolasch in connection with the prosecution of the present application. During the interview, it was pointed out by the Applicants that the present invention defines a unique catalyst composition which contains specific amounts of catalytically active components, that is, specific amounts of Ti, Mg and Cl, which when used in a polymerization process produces homopolymers and/or copolymers of either high density polyethylene (HDPE) or Linear Low Density Polyethylene (LLDPE) with a controlled morphology, having one or more of the following properties, that is, high bulk density, a very small quantity of fines in the product, good co-monomer insertion, improved catalytic activity with low catalytic decay, and a substantial homogenous distribution of the alpha-olefin within the polymer chain in connection with LLDPE.

The Examiner's concern raised at the interview was the Applicants' ability to show a "nexus" between the Applicants' specific catalyst composition and the product produced by the use of the Applicants' catalyst composition, said product having the advantageous properties

referred to hereinabove. Although it is believed that the Applicants have made such a showing by way of Examples and comparative data provided in the original application as well as during the prosecution of the present application, the Applicants are resubmitting all of the Applicants' documentation by presenting this evidence of patentability in the form of a Declaration under 35 USC 132 in an effort to build the nexus between the catalyst and the products produced by the catalyst.

Also, the Applicants are submitting, by way of secondary considerations, an additional Declaration directed to preliminary commercial success as well as the strong likelihood of future commercial success involving the catalyst composition of the present invention as well as the products produced by the catalyst composition of the present invention.

Concerning the Examiner's rejections of the claims, as discussed on pages 2-4 of the Examiner's Office Action letter, although the Examiner admits, and the Applicants concur that Luciani I, Luciani II and Neste lack disclosures with respect to thermo treatment, washing, as well as other various preferred embodiments of the present dependent claims, the main focus of the present invention, as discussed at the interview with the Examiner and his Supervisory Examiner, is the specific catalyst, a process for producing such a catalyst, as well as a process for the polymerization or copolymerization of a polyolefin such as polyethylene, using such a solid catalyst. The composition of the catalyst of the present invention which contains Ti, Mg, Cl alkoxy groups and organo metallic compounds and the use of non-polar organic solvents to impregnate the particular silica, defines a catalyst system having a different behavior which, in turn, produces a different final product in the polyolefin polymerization and copolymerization process. That is, because the present invention utilizes a specific amount of titanium, a specific amount of magnesium and a specific amount of chlorine, which remains fixed on the solid catalyst component and because of the use of inert organic solvents (non-polar solvents), it is possible to produce particles of homo and copolymers of olefins, for example, ethylene, with controlled morphology, having a high bulk density and containing a very small quantity of fines. The catalyst system of the present invention is also effective in achieving good co-monomer insertion into the final product as well as improved catalytic activity and low catalytic decay.

Catalyst systems currently being used in polymerization processes are based on the use of a magnesium dichloride support with titanium sites deposited on the support which is a very high activity catalyst in LLDPE copolymerization. As known in the state of the art, this kind of support produces a catalyst with a high degree multiplicity of titanium sites and because of this fact, the comonomer response LLDPE copolymerization is heterogeneous. This heterogeneous behavior is due to the fact that the titanium sites have a different steric and an electronic neighborhood. This heterogeneity is reflected on the higher xylene soluble fraction which is generated when the LLDPE is produced. With the intention of getting more homogeneity of the titanium sites and, consequently, better comonomer response, Luciani I and Luciani II added a compound to the process known as a donor or electron donor compound. This donor was added in the catalyst synthesis or during the polymerization and acts as a selective poison for some of the titanium sites. The way it acts is based on Lewis Theory (G.N. Lewis, 1923), which says that in acid-base reactions "bases donate pairs of electrons and acids accept pairs of electrons". In Luciani I and Luciani II, an aromatic or aliphatic ester is used for a solution preparation of magnesium and titanium compounds. In this case both magnesium and titanium compounds used in the solution preparation act as Lewis acids and the ester, which has oxygen groups, acts as a Lewis base. When this solution is deposited over an inert support, part of this donor remains bonded to the titanium or magnesium sites. This kind of selectivity poisoning of titanium or magnesium sites affects the behavior thereof during copolymerization generating more homogeneous sites. This higher homogeneity of the sites, consequently, affects the xylene soluble fraction content which becomes smaller during the copolymerization. Examples of Lewis acids are titanium and magnesium compounds and of Lewis bases are compounds with oxygen, nitrogen groups (water, ester, ether, amines, etc.) which have extra electrons to donate.

As can be seen by referring to the present application, no electron donor or donor is used, as detailed in the Summary of the Invention, in the Detailed Description and in the Claims. In the present invention, the homogeneity of the sites of the solid catalyst component is reached through the amounts of components present in the solid catalyst and in the fact that no donor or electron donor is used during the solid catalyst component preparation.

Table 1 compares the amounts of Ti, Mg, and Cl present in the catalyst system of the present invention with that of Luciani I, Luciani II and Neste.

TABLE 1 – Elemental ranges

	Present Application	EP 0480435 B1 Luciani I	EP0522651 B1 Luciani II	WO91/08239 Neste
Ti range (% w/w)	0.5 - 2.0	3.9 – 4.5 (outside)	3.7 – 4.4 (outside)	3.2 – 4.9 (outside)
Mg range (% w/w)	0.3 - 3.0	2.7 – 5.0 (outside)	3.4 – 3.9 (outside)	0.70 – 1.75 (inside)
Cl range (% w/w)	5.0 - 12.0	17.7 – 21.0 (outside)	12.4 – 19.7 (outside)	12.2 – 22.5 (outside)
TOTAL (% w/w)	5.8 – 17.0	24.3 – 30.5 (outside)	19.5 – 28.0 (outside)	16.1 – 29.15 (barely inside)

The important aspect regarding the elemental ranges (Table 1) is that in Luciani I, Luciani II and Neste, the Ti amount is very high and to activate these sites it is usual to use a high amount of the cocatalyst which is usually an aluminum alkyl. This aluminum alkyl acts, in this case, as a Lewis acid and can remove from Ti and also from Mg sites, any donor or electron donor compound, beyond its function as reducing and alkylating agent. In both Luciani I and Luciani II patents they use a donor or electron donor as a solvent for the titanium and magnesium solution. The remaining donor at the final catalyst can be removed by this aluminum alkyl, during the polymerization. One of the reasons to use a donor, as mentioned before, is to obtain homogeneity on titanium sites and, consequently, obtain fewer sites which produce the xylene soluble fraction in LLDPE. Consequently, when the catalyst has a high amount of titanium sites, the comonomer response is not as good as that of the present invention which uses a catalyst with a very small amount of titanium. Table 2 below demonstrates a comparison between examples from Luciani I, Luciani II and Neste and an example of the catalyst of the present invention, used in copolymerization of ethylene and butene-1 to produce a LLDPE product. The examples from Luciani I, Luciani II and Neste were reproduced in the lab and used in copolymerization, as shown in Table 2.

Table 2

Comparative Test Number	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	TEST 6	TEST 7	TEST 8
Product	LLDPE	LLDPE	LLDPE	LLDPE	LLDPE	LLDPE	LLDPE	LLDPE
Catalyst from	EP 0522651 B1 patent (Example 1)	EP 0522651 B1 patent (Example 4)	EP 0480435 B1 patent (Example 3)	EP 0522651 B1 patent (Example 1)	WO 91/08239 patent (Example 10)	WO 91/08239 patent (Example 10)	WO 91/08239 patent (Example 10)	Patent Application - 0315-0158PUS1 (Example 8)
Ti (%w/w)	6.8	5.2	5.6	6.8	3.9	3.9	3.9	2.0
Mg (%w/w)	2.7	3.4	2.3	2.7	1.9	1.9	1.9	1.5
Aluminum alkyl	TEAL	TEAL	TEAL	TEAL	TEAL	TEAL	TEAL	TEAL
Ethylene partial pressure (bar)	5	5	5	5	5	5	5	5
Temperature (°C)	75	75	75	75	75	75	75	75
Time (h)	3	3	3	3	3	3	3	3
Al/Ti	300	300	300	300	300	300	300	300
Butene-1 (L)	0.29	0.29	0.29	0.7	0.29	0.7	1.1	0.29
H ₂ /C ₂ molar ratio	0.47	0.47	0.40	0.40	0.47	0.40	0.35	0.40
Bulk Density (g/cm ³)	0.26	0.30	0.27	0.29	0.30	0.31	N.A.	0.36
Fines (%)	N.A.	3.0	2.8	2.2	1.5	1.7	N.A.	0.1
MFI (2,16) (g/10 ³)	1.00	1.30	0.40	1.34	0.29	1.25	1.30	0.91
Butene content (% w/w)	5.7	6.7	4.7	9.7	5.5	N.A.	N.A.	8.7
Density (g/cm ³)	0.938	0.925	0.928	0.918	0.925	0.923	N.A.	0.917
Xylene soluble (% w/w)	5.3	7.3	6.9	14.2	3.0	5.2	N.A.	9.7

N.A. = not analyzed

The copolymerization condition to specify a LLDPE product, with MIE close to 0.8 - 1.3 g/10 min range and a density close to 0.9170-0.9190 g/cm³, for catalyst Example 8 of the present invention is demonstrated in Test 7 of Table 2 (see the description of polymerization conditions on Example 12 of the present application). It can be seen in Table 2, that this copolymerization condition was the same for all Tests with the exception of Tests 4 and 6, where a higher amount of butene-1 was used (0.70 L). It can be seen from Table 2 that, using the same conditions of Test 7, from the present application, neither catalysts from Test 1, 2, 3 nor 5 showed a LLDPE

product with a Density close to that obtained in Test 7. To obtain the same range of MIE of LLDPE obtained in Test 7, it was necessary to have a higher H₂/C₂= molar ratio for Tests 1, 2 and 5. To obtain a LLDPE product with a density closer to that shown in the Test 7, it was necessary to use higher amounts of butene-1 during the copolymerization, as can be seen in Test 4. For the catalyst example from Neste, it was not possible to obtain a density between 0.9170-0.9190 g/cm³, with the amount of 0.70 L of butene-1, as can be seen in Test 6.

In all of these products the xylene soluble fraction was analyzed. When the same kind of product is compared for Tests 4 and 7 (LLDPE with the same MIE and Density ranges), it can be seen that the xylene soluble fraction is quite different (14.2 and 9.7 % w/w, respectively). These different xylene soluble fraction results are due to the following facts:

1- High amount of Titanium: to activate these sites it is usual to use a high amount of the cocatalyst which is usually an aluminum alkyl. This aluminum alkyl acts, in this case, as a Lewis acid and can remove from Ti (and also from Mg sites), any donor or electron donor compound - in Luciani I and Luciani II a donor or electron donor is used as a solvent for the titanium and magnesium solution.

2- Low amount of Ti and Mg in the present invention - the smaller xylene soluble fraction is due to the lower amount of titanium and magnesium relative to the silica support and the ratio between titanium and magnesium compounds used.

Response to Arguments Made by the Examiner

On pages 4-7 of the Examiner's Office Action letter, the Examiner has presented certain arguments to which the Applicants would like to respond. Accordingly, attached to the present Amendment and identified as Appendix I is the Applicants' response to all of the Examiner's arguments set forth in the Office Action letter. In the Appendix itself, the Examiner's arguments are restated followed by the Applicants' response to each of these arguments. Also, attached to

the Appendix is a list of references referred to in the Applicants' responses to the Examiner's arguments.

Conclusion

The present invention is directed to a process for producing a solid catalyst component used in the polymerization of olefins, for example ethylene, as well as a solid catalyst component per se and a process for the polymerization or copolymerization of a polyolefin such as polyethylene, using such a solid catalyst. In the present invention, because a specific amount of titanium, a specific amount of magnesium and a specific amount of chlorine are utilized and remain fixed on the solid catalyst component and because of the use of inert organic solvents "non-polar solvents," it is possible to produce particles of homo and copolymers of olefins, for example, ethylene, with controlled morphology having a high bulk density and containing a very small quantity of fines. The catalyst system of the present invention is also effective in achieving good co-monomer insertion into the final product as well as an improved catalyst activity with low catalytic decay.

The Examiner appears to have taken a position that the prior art teaches an amount of Ti, Mg and Cl, from which, the Applicants' specific amounts of catalyst components can be calculated. Even if, for the sake of argument, the Examiner's position was considered to be correct, the present invention has discovered that when using specific amounts of the various components of a catalyst system, said components cooperate in effectively producing homo and copolymers of olefins with a controlled and desired morphology. Recreating this discovery from broad ranges allegedly present in the prior art requires a reconstruction of the teachings of the references in view of the Applicants' inventive contribution. Furthermore, although the Examiner argued at the interview that he could calculate the amounts of catalyst components using the range of Ti/Mg solution from step (a) from Luciani I and step (ii) from Luciani II, this approach is not correct because the catalyst synthesis involves different kinds of unit operations,

such as for example, filtration, decantation, multiple washes and the like which would make a calculation substantially impossible.

Accordingly, in view of the above amendments and remarks and particularly in view of the two Declarations submitted herewith, it is believed that all of the claims of the present application are patentably distinguishable over the prior art relied upon by the Examiner and accordingly reconsideration of the rejections and allowance of all of the claims of the present application are respectfully requested.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Joseph A. Kolasch Reg. No. 22,463 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

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Respectfully submitted,

By 

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Attachments: Appendix
Rule 132 Declaration
Commercial Success Declaration